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NOTES ON THE DESCRIPTION OF LAND FORMS—XII

Physiography in New Zealand.

THE PHYSIOGRAPHY OF THE MIDDLE CLARENCE VALLEY, NEW ZEALAND.
By C. A. Cotton, Victoria College, Wellington, N. Z. *Geogr. Journ.*, Vol. 42, 1913, pp. 225-246.

The geographical factor of distance has been recognized as of value in anthropogeography, inasmuch as its increase tends to weaken the influence of home-country traditions in a colony. The socialistic legislation of New Zealand, strikingly unlike the more conservative legislation of Great Britain, is a well known instance of the operation of the distance factor in governmental matters: the article cited above is an instance of it in geographical matters.

The colonial author of this exceptionally lucid paper discards traditional and conventional British methods and makes conscious application of a comparatively new, systematic and explanatory method in his physiographic description. First comes a page of helpful introduction; next follow two pages of "Brief Description," in which the essence of the story is concisely

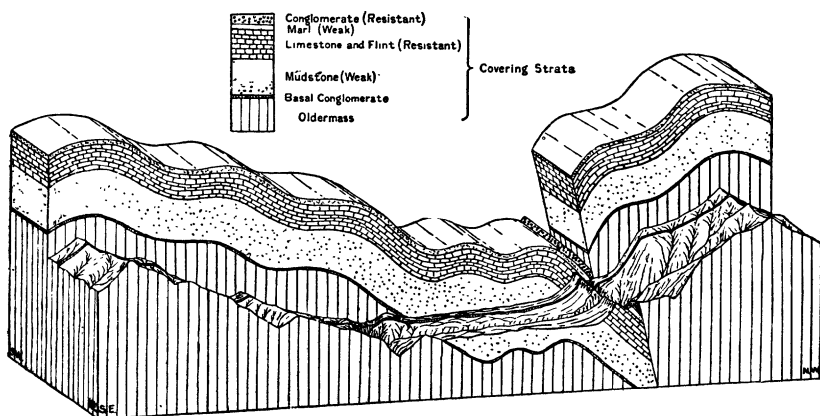


FIG. 1—Diagram illustrating the type of structure and sculpture in the Middle Clarence Valley.
(*Geographical Journal*, Vol. 42, 1913, No. 3, p. 227.)

told; fourteen pages are then given to a fuller treatment of six topics that were lightly touched in the "Brief Description"; and four pages of a geological appendix close the article. The illustrations include a location map, an excellent block diagram (Fig. 1), six effective outline sketches, and five photographs. Evidently the needs of the reader have received due consideration by the writer, and, as a result, his work quickly gains due recognition from the reader. When a paper follows a systematic order, as this one does, it gives the impression of a completed story; and a paper that gives the impression of completeness is probably based on a study that was carried through with thoroughness. When a paper possesses, as this one does, the invaluable quality of lucidity, it is highly probable that the investigation on which it was based possessed the equally desirable quality of accuracy.

One here learns that, according to this author, in a great compound mass, consisting of a disordered and worn down "oldermass" originally buried

beneath some 12,000 feet of "covering strata," "two anticlinoria are represented with an intermediate synclinorium" trending northeast-southwest, the northwestern limb of the synclinorium being "replaced by a reversed fault of enormous throw." The anticlinoria no longer preserve their cover, but are deeply carved by normal processes into two one-cycle mountain ranges of strong relief, known as the inland (northwestern) and the seaward (southeastern) Kaikoura ranges. Between them is a long and broad consequent valley-lowland—the Middle Clarence valley, worn down on the weak covering strata of the faulted synclinorium, except that an unconsumed monoclinial ridge of resistant limestone with northwestward dip survives near the fault line at the base of the inland range; but as a result of relatively recent rejuvenation by regional uplift, of which the headwater streams in the mountains do not yet take notice, the main rivers are now entrenched in narrow valleys beneath the remnants of the former lowland floor, save that Clarence river itself no longer flows in the belt of weak covering strata, but is incised in the oldermass along the border of the seaward range, seemingly superposed from a former extension of the cover. Some of the mountain streams "must now be superposed consequents"; others which descend the mountains obliquely instead of directly are perhaps guided by weak belts in the oldermass, and "may be classified provisionally as subsequents."

Special attention should be directed to certain excellent features of Cotton's article. It makes free use, without stopping to explain them, of such systematic terms and phrases as consequent, subsequent, superimposed, antecedent, grade, rejuvenation, normal erosion agencies, one-cycle mountains and elbow of capture, as if its pages were written for mature geographers of some reasonable proficiency in their science. The sequence of parts is carefully arranged, so that the reader advances easily from large features to detailed features. "The account given of the geological structure is limited to the minimum required in explaining the relief"; all geological formation names are relegated to an appendix. The "Brief Description" contains no local, unexplained place-names as guides to the location of physiographic features; only four place names are there introduced and they are located with respect to the physiographic features. On the other hand, it may be questioned whether the historic order of presentation, not followed in the above abstract, is best for the presentation of a visible product of change, not a past process of change; whether the historic style, with its prevalent use of the past tense, is most satisfactory for the description of present forms; whether certain phrases might not be changed to advantage from descriptive explanations to explanatory descriptions; and whether a few more dimensions, such as miles of length and breadth, and feet of height, should not have been added to the "Brief Description." But these are small matters, or rather they are niceties, almost too delicate for mention in the discussion of any articles but the best.

The Lakes of the Balkan Peninsula.

L'ANCIEN LAC ÉGÉEN. By J. Cvijić. *Ann. de Géogr.*, Vol. 20, 1911, pp. 233-259.

This geological article by the professor of geography in the University of Belgrade is largely concerned with the study, which he has most persistently and enterprisingly carried on, of an extensive Pliocene lake that occupied the southern part of the Balkan peninsula, inland from Salonika, as well as part of the later-formed Aegean Sea. The article was probably accepted for publication in a geographical journal because the reconstitution of the extinct lake is based in large measure on physiographic evidence, as well as because the history of the extinct lake contains much excellent and novel physiographic information. The article is here reviewed in order to examine the manner in which its physiographic elements are stated and applied.

The region under discussion contains a good number of existing lakes, nearly a score being shown on one of the maps accompanying the article, some with outlets, some without, but all occupying local basins in what was once the bottom of the extensive and irregular Pliocene lake, to which the name,

Aegean, is given. The local basins are explained at the outset as "tectonic depressions of recent date," often determined by down-faulted troughs (p. 234). This statement is physiographically incomplete, because it gives no idea as to the character of the surface before it was deformed and faulted; hence the reader is here left in uncertainty as to the nature of the tectonic basins, unless he happens to know beforehand the Pliocene or pre-Pliocene topography of the region. Attention is called to the incompleteness of the statement, because it is an example of a frequently employed but essentially imperfect method of description, which neglects an important three-fold principle of physiographic presentation, namely:—Whenever mention is made of a crustal movement as a factor in the explanatory description of the existing form of a land surface, the form that the surface had before the movement took place and the changes that it has suffered since the movement, as well as a sufficient account of the movement itself, should be included in the statement; in other words, when a cycle of erosion is interrupted by a crustal movement that places the land mass under consideration in a new attitude with respect to base-level and thus introduces a new cycle of erosion, the stage of development reached in the first cycle when it was interrupted and the stage reached in the second cycle since it was introduced, as well as the interrupting movement, should all be stated.

For example, if a certain coastal district is said to owe its present shoreline to a movement of depression, it is essential to know the form that the district had before the depression took place, as well as the estimated amount of depression, in order to conceive the new shoreline in its initial stage; and then to know the changes that have since been produced by river and marine action, in order to conceive the present shoreline. Again, if a district is described as traversed by a fault, it is essential in a physiographic description to know the pre-faulting form of the surface—unless it is all destroyed—and the changes since faulting, as well as the direct effects of the fault itself. In both cases it is, in the present writer's opinion, highly desirable to state the pre-depression or the pre-faulting forms of the districts concerned in terms of the structure of their rock mass, of the agencies that have worked on it, and of the stage reached by the agencies in their work.

In the present case the changes since deformation may be inferred to be small, because the deformation is said to be recent; but these post-deformational changes may not be immediately essential, because the author's object is apparently to indicate the form of his district soon after the deformation took place; yet on a later page (253) explicit mention is made of significant erosional changes produced on the deformed surface before its occupation by the Pliocene lake. The very brief statement regarding the down-faulted troughs and the absence of statement regarding the dimensions of the fault scarps that bound the troughs and regarding the post-faulting changes in the scarps are regrettable, but the omission of the pre-deformational form is a still more serious deficiency in an explanatory description. The deficiency is partly made up on a later page, where it is said that the basins are sunk in a pre-existent "plate-forme" (249); further, that detached fragments of large pre-deformational valleys are still recognizable in the uplands between the troughs; and that domes and other reliefs appear in the basin floors (250-252). This is good as far as it goes; it evidently suggests that domes and other reliefs are to be inferred upon the uplands also, although they are not directly mentioned here, perhaps because they are not directly related to the lake problem. Finally, at the very end of the article (258, 259), a brief statement is made regarding the form of the highlands. Why these illuminating details are distributed through later pages instead of being concisely and pertinently stated at the beginning, and why no brief mention of structure is included when the pre-lacustrine platform is described, is not readily understood. The author presumably had some reason for the distributed arrangement, but the reason is not apparent to the reader, whose mental picture of the region must float vaguely while he reads the body of the article, unless he impatiently looks ahead for help, as some readers do. Would it not be well, in such cases as this, for the author to serve the reader's needs more directly, by describing the fundamental land-forms at the beginning?

The maximum extension of the Aegean Lake is inferred in part from its fresh-water sediments which sometimes spread over the lower uplands, but which, aided by the sediments of the later dwindling lakes, are heavier on the basin floors; and in part from its built shore-line terraces and its abraded benches, of which the highest two have altitudes of 740-800 and of 670-680 meters. The highest terraces and benches, as well as the lower terraces formed during the dwindling of the extensive lake, are not easily apprehended as geographical features from the statements of the text; perhaps the author did not intend that they should be. But inasmuch as they are mentioned, the reader naturally strives to conceive their appearance; and his difficulty is, as before, that the three-fold principle of physiographic presentation, essential for a clear account of such features, is again neglected. First, the initial forms of the lake shores are so imperfectly stated that they cannot be understood; second, the stages reached in the development of the built terraces and the cut benches are not announced, and nothing is told of deltas in connection with the terraces, or of cliffs at the back of the benches, although the benches are said to transect the rock structure and to extend over "vast surfaces" (258); and third, the amount of post-lacustrine dissection suffered by these features is hardly mentioned, although special account is given of certain epigenetic streams which often follow meandering gorges in the resistant under-rocks into which they have cut down from the consequent courses assumed on the lacustrine sediments, as the lake waters fell to lower and lower levels. Whether the broad benches are properly interpreted as due to lacustrine abrasion is not here discussed; but it may be noted that corresponding surfaces farther north are said by Cvijić to have been described as normal peneplains by de Martonne.

In so far as the object of the paper is geological, geographical readers must feel grateful to its author for incidentally providing them with so much physiographic material, even though they may regret that the material is not more systematically and effectively presented, as it might easily have been. In so far as the object of the paper is geographical, as might be inferred to be the case from its preparation by a noted professor of geography and its publication in an excellent geographical journal, its readers must more seriously regret that the present consequences of past crustal deformation and temporary lacustrine occupation are not set forth in such a manner that the resulting landscape of to-day can be more definitely and completely pictured. Whether this result could be secured by the adoption of the three-fold scheme of presentation, above indicated, can be best determined by comparative experiment. Let a given district be described first in the way adopted by Cvijić, and next according to the three-fold scheme; and then test the relative success of the two descriptions by reading them to some innocent but competent listener, who is uninformed as to the issue at stake. Experiment of this kind is strongly recommended to young geographers, whose habits in writing geographical descriptions are not yet formed.

W. M. DAVIS.